Annals of DAAAM for 2010 & Proceedings of the 21st International DAAAM Symposium, Volume 21, No. 1, ISSN 1726-9679
ISBN 978-3-901509-73-5, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2010
Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird
DAAAM Symposium

E-LEARNING APPLICATION IN TEACHING OF THE BERTRAND PRICE MANAGEMENT OLIGOPOLY

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Abstract: *This paper analyzes how E-learning and non-E-learning techniques affect the comprehension of the complex microeconomic theories such as Betrand equilibrium. Bertrand equilibrium is chosen for the analysis since it describes many oligopolistic markets, on which companies try to earn extra profits by entering small market niches and managing the price in a non-cooperative way. The findings show that 82%of the students who were taught using E-learning techniques had a full understanding of the Bertrand model, as opposed to the 55% of the non-E-learning students. It suggests that an average economics student is more receptive to the graphical and intuitive representation than to the algebraic proofs and deductions.*

Key words: *E-Learning, Microeconomics, Corporate cooperation, Price management, Software application, Bertrand equilibrium*

1. INTRODUCTION

The main problem of a teacher of microeconomics is how to explain specific microeconomic theories in the simplest way. In the postgraduate level, having students with strong mathematical background, there is no need to avoid mathematical expressions and explanations, but on the undergraduate level, teaching microeconomics in the 2nd semester as it is on the Faculty of Economics and Business in Zagreb, a large number of students have not yet acquired the calculus skills required for the microeconomic analysis.

However, the number of graphical software, e.g. Mathematica 7.0., can show what a yet mathematically underdeveloped mind cannot grasp. Using Mathematica helps transforming the complex functions into graphs and interactively by changing the coefficients get closer and closer to the solution. Hence our hypothesis is that the e-learning methods here introduced ensure better understanding and thus better grades in microeconomics.

2. PAPER DATA

The learning methods can be grouped into at least three categories: (1) autonomous: guided reading; programmed instruction (distance learning, computer based learning), (2) collaborative: games/simulations; projects; case studies; experiential; role playing and (3) dependent: lecture; seminar (Sadler-Smith 1996). Our E-leraning project can mainly be put in the 2nd group. The effectiveness of the E-learning groups, as opposed to the non-E-learning groups is proven in the survey made in the Egyptian universities (El-Deghaidy, Nouby, 2008).

The software can be used for the simplification of teaching of microeconomics in several fields, e.g. with the complex deductions. Graphical applications can be used to explain a concept of concave and quasi-concave functions and its layer curves (Galetić et al. 2008).

The application of the E-learning techniques in the everyday class-preparation is advocated in (Shih, Tseng, Yang, 2008). It is shown that E-learning techniques improve not only the teaching but the teacher himself (Chiu, Weng, Sheng, 2009).

In a survey made on the university students in Taiwan who took quantitative methods courses, it is shown that these students yield better results if they were taught using E-learning techniques (Su, 2008). Author provides several suggestions on how to implement the E-learning techniques for this kind of courses, and can be very useful for teaching microeconomics since microeconomics uses quantitative methods intensively.

The problem of teaching mathematically intensive theories, just as it is the case in this paper, can be made easier using the E-learning methods proposed by Mangina and Kilbride (2008) in the teaching of the models that use vector space. It has been shown that even the students with weaker mathematical background can be taught the more complex models if the adequate E-learning techniques are used.

3. TEST GROUPS AND A SURVEY

In order to test the hypothesis, the authors of this paper made a survey on nine tutorials groups in microeconomics in the period from 2005 – 2008. Four of the groups were taught using e-learning techniques. The survey analyzed eleven different lectures in a period of one semester, while here only a part of one lecture's effectiveness is presented; Betrand equilibrium is taught as a part of the 8th lecture, when different types of oligopolies are introduced.

The reason for choosing Bertrand equilibrium only is the fact that it describes a rather frequent market situation (Perloff, 2009); it is the case when several big players on the market notice that it the war with quantities is not so profit yielding. That is why they start to differentiate their products, thus enabling them to set different prices than those of the opponent. After the similar moves of the other players on the market, the rest of them start to adjust their price management decisions in order to maximize profits. It moves the market asymptotically towards the equilibrium.

Very important property of this theory is that managers do not cooperate. Since the antitrust legislation has become very strict (e. g. IBM), this assumption is very realistic since no government would look benevolently on the cartel agreement. That is why managers tend to form a bit different product than the one offered by the competition, thus entering a small unfilled niche in the market and taking extra profit. Of course, the extra profits slump when the number of players increase, so the most often case of this behaviour is when there are from two up to seven companies on the market (Pindyck, Rubinfeld, 2008).

The method used for testing the hypothesis is the plain descriptive statistic value, the proportion of students who gave the correct answer on the question "Explain the main concepts of the Betrand oligopoly". The overall test consisted of 15 multiple choice questions, 5 problems and five essay questions, one of which was the previously mentioned one.

The final results, which have shown the overall better performance of students who were taught using E-learning techniques (Herceg et al., 2008), suggest that the hypothesis should not be rejected: it was shown that 82% of students who were taught the Bertrand model using e-learning techniques got full 5 points, while only 55% of the non-e-learning students had the same score.

4. E-LEARNING TECHNIQUES

Due to the effectiveness of the e-learning techniques used in teaching of Bertrand duopoly, this section briefly introduces the methods used in the classroom. Instead of a complicated algebraic expression, an easy example was taken:

$$\begin{aligned} Q_A &= 100 - 3P_1 + P_2 \\ Q_B &= 100 + P_1 - 3P_2 \\ TC_1 &= 10 + 2Q_1 \\ TC_2 &= 10 + 2Q_2 \end{aligned} \qquad (1)$$

In this example the 1st two expressions represent demands, and the last two total costs. Together with students, the teacher deducts profit functions using Mathematica 7.0. The following graph is obtained:

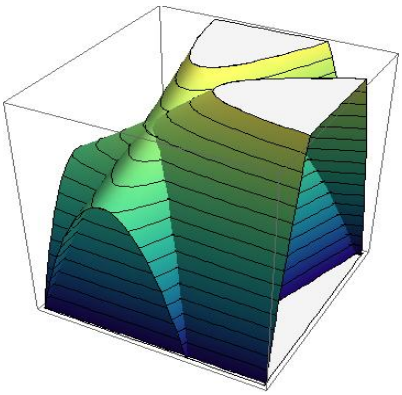

Fig. 1. Betrand duopoly profit functions

Students are told that the concept of "reaction curves" can be easily seen as the ridge of the function, and the teacher rotates the picture in order to show them how it correspond to the picture that students have already seen in 2D as a projection of this graph (Fig.2)

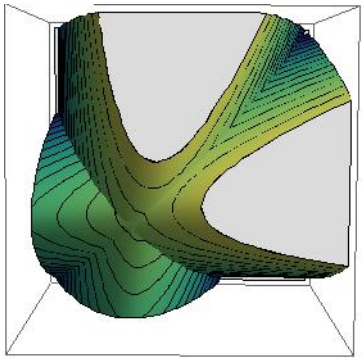

Fig. 2. Betrand duopoly profit functions top view

Now students can see how the equilibrium is obtained and that the ridges indeed correspond to the reaction curves. The students who have not yet grasped the main concepts of calculus now see why profit function derivative corresponds to the ridge, which correspond to the reaction curves.

The following step is to pull the isoprofit curves and draw reaction curves, which are calculated automatically using software (Fig.3). After this, students choose different parameters in order to see how the situation changes when demand and costs change. Finally, the teacher might even introduce some algebraic calculus and show what the graph has already shown. If not, the solution can be obtained by approximation only.

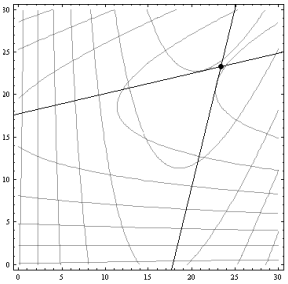

Fig.3. Contours of the profit functions and the reaction curves

In this way the teaching time is much more effectively utilized, while students' sense of participation is risen as well as their eagerness to attend the next class.

5. CONCLUSION

E-learning techniques using graphical software are especially useful for the applied mathematics courses since they enable the comprehension of the matter without the use of calculus. The results of the survey show that more than 80% of the E-learning students have fully understood the concept previously mentioned, while only about a half of the non-E-learning students manage the same. The techniques here presented show that only a small effort and minimum resources are required much higher level of comprehension of the lecture.

6. REFERENCES

Chiu, H-Y., Wen, S-Z, Sheng, C-C. (2009), Apply Web 2.0 tools to constructive collaboration learning: A case study in MIS course, Fifth International Joint Conference on INC, IMS and IDC, Taiwan.

El-Deghaidy, H., Nouby, A. (2008), Effectiveness of a blended e-learning cooperative approach in an Egyptian teacher education programme, Computers & Education 51 (2008) 988–1006

Galetić, F., Herceg, T., Jaković, B. (2008): E-learning and Its Application to Microeconomics, *WSEAS Transactions on Information Science & Applications*, Issue 4, Volume 5

Herceg, T., Jaković, B., Galetić, F, (2008) „Application of Graphical Software in Teaching of Microeconomics – Lecture Monopoly", Proceedings of the 19th International DAAAM Symposium „Intelligent Manufacturing& Automation: Focus on Next Generation of Intelligent Systems and Solutions", 22-25th October 2008, Trnava, Slovakia.

Mangina, E., Kilbride, J., (2008), Utilizing vector space models for user modelling within e-learning environments, Computers & Education 51 (2008) 493–505

Perloff, J.M. (2009), Microeconomics, 5th edition, Pearson Addison Wesley, Moston, MA, USA.

Pyndick, R.S., Rubinfeld, D.L. (2008), *Microeconomics*, 7th Edition, Pearson Prentice Hall, Upper Saddle River.

Sadler-Smith, E. (1996), Learning styles: a holistic approach. *Journal of European Industrial Training*, Volume: 20 Issue: 7; Research paper.

Shih, W-C., Tseng S-S., Yang C-T. (2008), Wiki-based rapid prototyping for teaching-material design in e-Learning grids, *Computers & Education 51 (2008) 1037–1057.*

Su, K.D., (2008), An integrated science course designed with information communication technologies to enhance